Entomological Issues during the Korean War, 1950-1953

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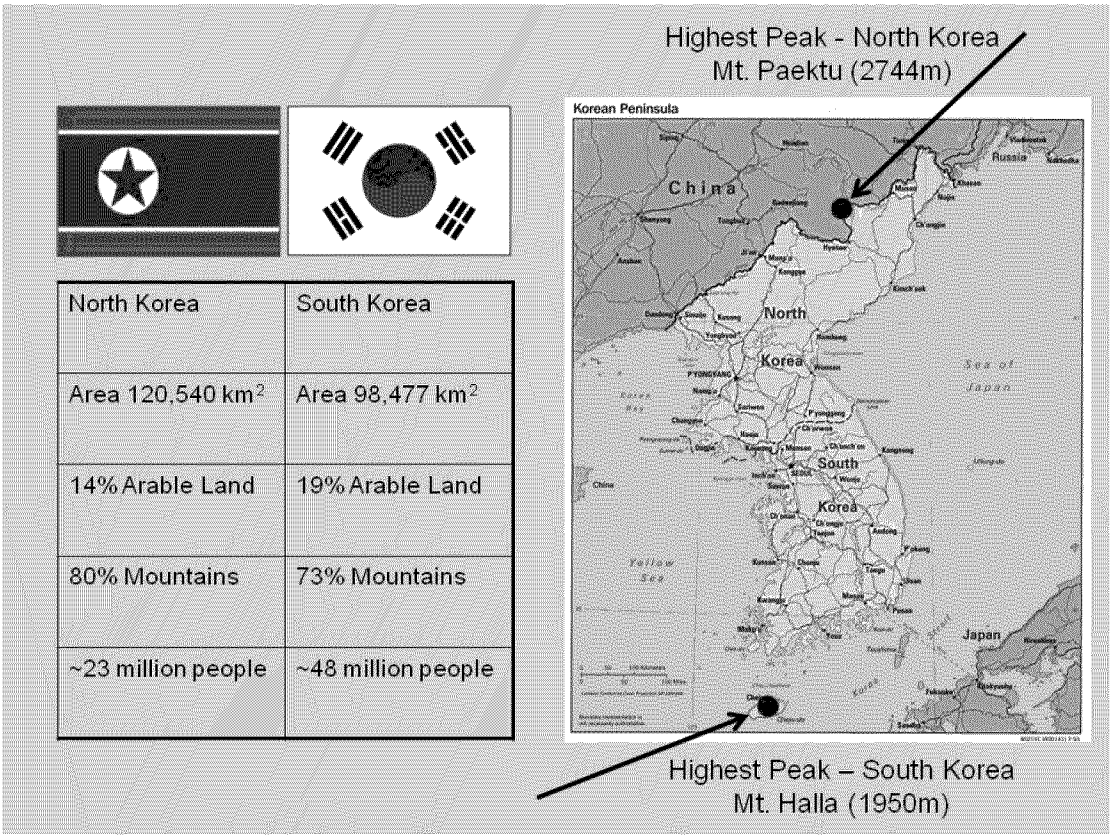
To understand entomological issues during the Korean War, one must first know something about Korea and the cultural and political situation during that period. Korea is a peninsular country that over the centuries has periodically been occupied by China or Japan. These occupations had a detrimental effect on the country because human and material resources were routinely stripped from the peninsula. The occupations and subsequent national freedom led to a strong sense of national pride in the Korean people and a not inconsequential xenophobia.

The Japanese occupation from 1910-1945 differed only in its magnitude. Koreans were enslaved and forced to work in war factories or other menial positions. The country experienced widespread deforestation at the hands of the occupiers, and the little wood that remained was gathered for cooking and heating. The widespread loss of forest cover led to landslides and flooding during the summer monsoons.

On September 2, 1945, the Japanese surrendered to the Allied Forces onboard the USS Missouri in Tokyo Bay. This signified the end of World War II and the beginning of the Allied occupation of northeast Asia. By prior agreement with the Union of Soviet Socialist Republics (USSR), Korea was split into two halves along the 38th parallel; the northern half became the Democratic People's Republic of Korea (North Korea) with USSR oversight, and the southern half became the Republic of Korea (South Korea) with United States (US) oversight. North Korea and South Korea are about the size of the states of Pennsylvania and Illinois, respectively, are 70-80% mountainous, and have less than 20% arable land; in 1950, their respective populations were estimated to be 23 and 48 million people (Fig. 1).

In 1949, the US considered South Korea an independent country that no longer needed the presence of US occupation forces, so US forces withdrew from Korea to established bases in Japan. North Korea, still backed by the USSR, took the US withdrawal as indifference to the region and decided it was time to forcibly reunite the country.

On June 25, 1950, North Korean artillery began firing south and North Korean troops began their invasion of South Korea. President Truman protested this action and ordered US military intervention; the United Nations (UN) considered North Korea's action an act of aggression, and sixteen nations under the auspices of the UN joined the ROK in expelling the aggressors. US troops stationed in Japan sprung into action but were too few to stop the North Korean military surge. Within months, the North Koreans occupied almost all of South Korea except for an area in the southeast around the city of Pusan, with the outer boundary referred to as the Pusan perimeter. The stalling action by UN forces allowed sufficient troops and equipment to enter the Pusan perimeter, and a UN offensive action was imminent.



North Korea	South Korea
Area 120,540 km^2	Area 98,477 km^2
14% Arable Land	19% Arable Land
80% Mountains	73% Mountains
~23 million people	~48 million people

Figure 1: Geographic information and map of North and South Korea.

After breaking out of the Pusan perimeter, General Douglas MacArthur implemented a surprise attack on September 15, 1950 at Inchon, a port city to the west of Seoul, effectively entrapping the North Korean Army and cutting off their supplies. Many North Koreans surrendered; the rest began an immediate and rapid retreat. By December 1950, UN forces had pushed the North Korean Army to within a few miles of the Chinese border. China then entered the war on the side of North Korea, and millions of Chinese soldiers marched into North Korea, pushing the UN forces south. Eventually, the war settled around the 38th parallel, and on July 27, 1953, an armistice was signed and a demilitarized zone established to create a buffer between the opposing forces. Numerous hostile actions have since been documented, underscoring the reality that South Korea and its allies are still not at peace with North Korea.

Korea was an agrarian society and infrastructure throughout the country was minimal in 1950. There were no highways until 1966, and much of the population still lived in traditional Korean housing. The aftereffects of WWII left the people impoverished and struggling to reestablish their lives with few resources and threats of catastrophic disease. The Korean War severely aggravated the problems for Koreans, many of whom were rendered homeless or displaced by combat actions (Figure 2). Disease was rampant during

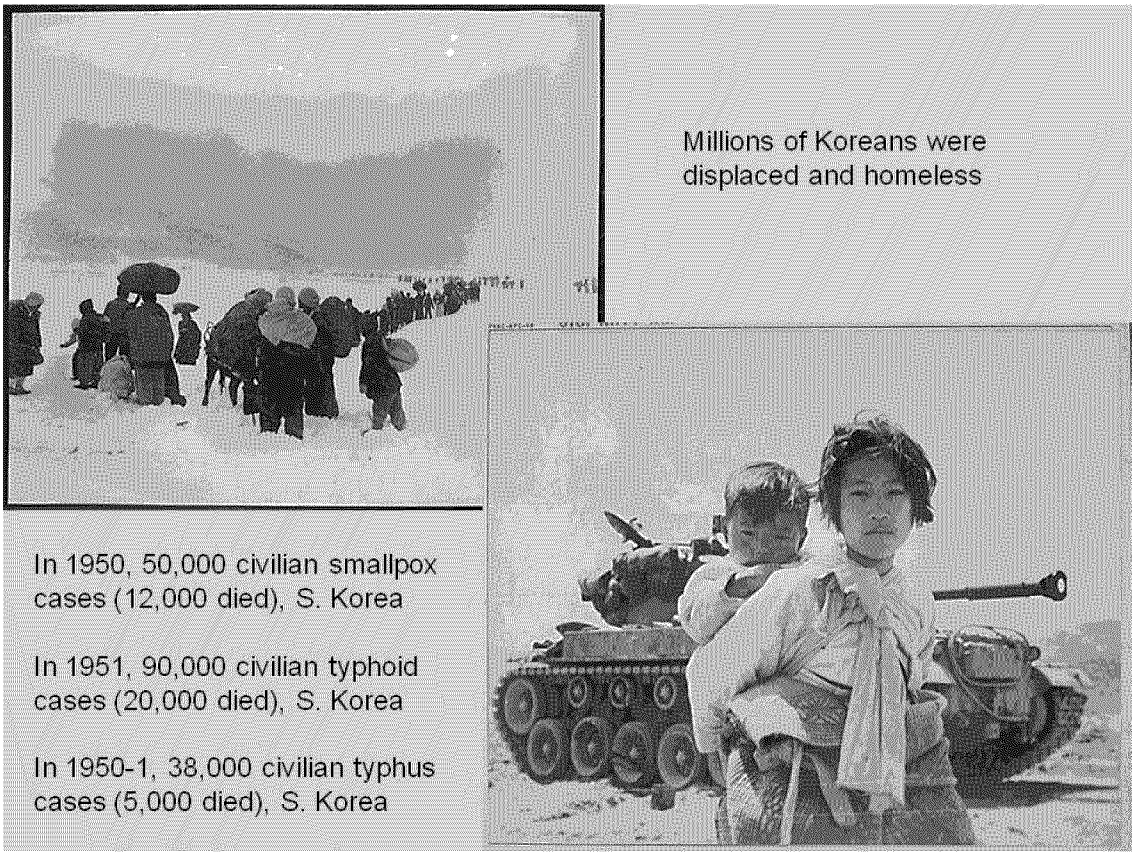


Figure 1: Displaced Koreans and combat actions suffered from disease and environmental exposure. Photos: US Army. (Disease data per Long 1954)

this period, with high morbidity and mortality due to smallpox, typhoid, typhus, other diseases, and harsh environmental conditions.

Living conditions for military personnel were generally open and makeshift. Soldiers were exposed to environmental extremes, and arthropod and rodent interactions were common (Figure. 3). For example, during the winter of 1950-1951, intense cold led to over 5,000 frostbite injuries in US forces (Shaver 1962). Arthropod-borne diseases (louse-borne relapsing fever and typhus, Japanese encephalitis, vivax malaria, and epidemic hemorrhagic fever) threatened all civilian and military populations.

Louse-borne diseases were holdovers from WWII and rapidly expanded as displaced Koreans relocated to crowded areas with inadequate hygiene and sanitation opportunities. Louse-borne typhus is estimated to have caused 32,000 cases and 6,000 deaths in South Korean soldiers and civilians. No US cases were reported in Korea; one occurred in Japan (Long 1954, Pruitt 1954).

Lice also affected prisoner of war (POW) camps and were of great concern at the Koje Island POW camp along the southern coast of South Korea. North Korean POWs were kept at this location, and a 10% DDT dust was used as the louse control agent. Over time, the DDT treatments did not appear to have an effect

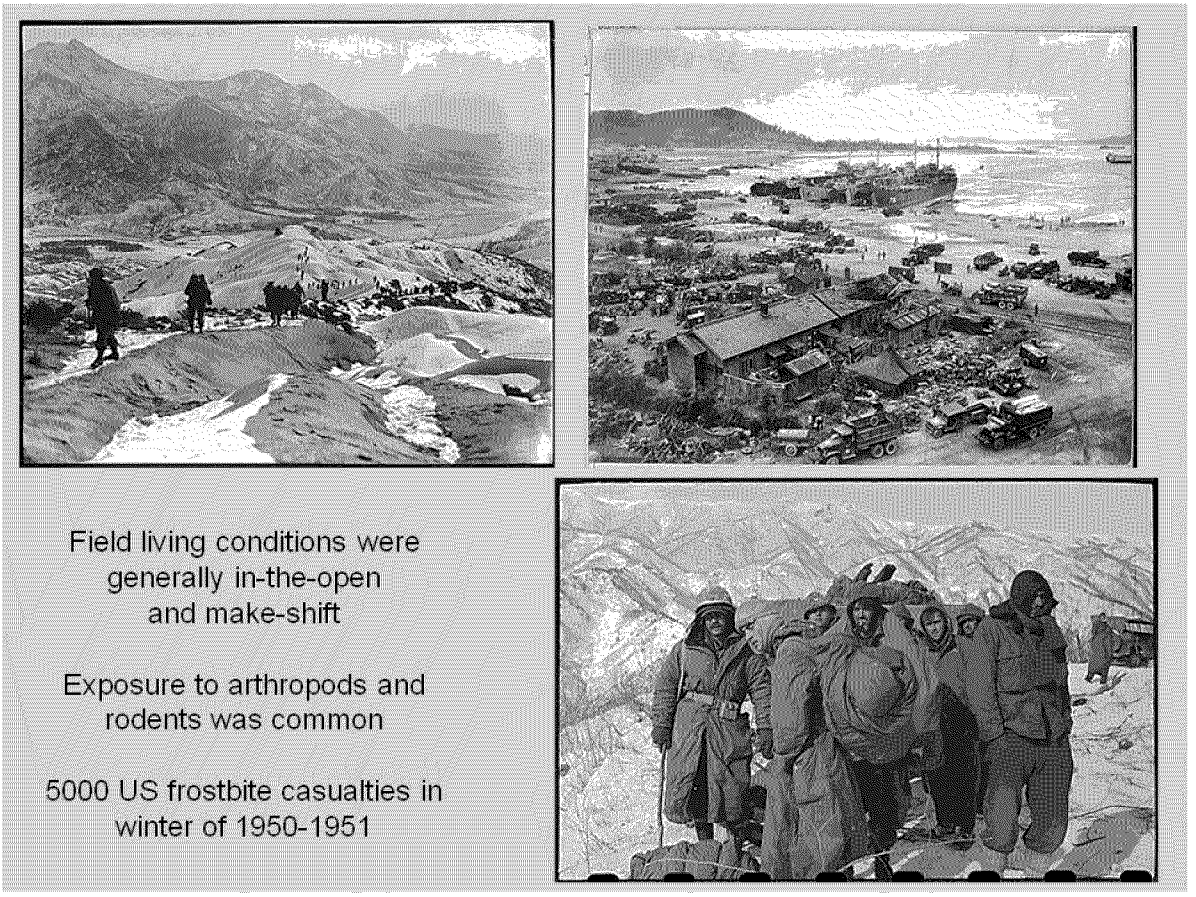


Figure 2. Examples of field living conditions for military personnel. Photos: US Army.

on the lice, and an investigation of the problem was initiated (Military Entomology Information Service 1965). Military entomologists suggested that the lice had become resistant to DDT and requested a new insecticide (Hurlbut 1960). However, authorities in the US felt that DDT was adequate and that the problem lay in its application or in a bad batch of the chemical (Dews 1960).

Fleet Epidemic Disease Control Unit No. 1 planned and conducted tests to evaluate DDT efficacy and louse Army and Navy entomologists from the 37th Preventive Medicine (PM) Company, the 297th PM Survey Detachment, and the resistance. (Figure 4). DDT was tested for its efficacy against *Culex pipiens* larvae (mosquito species), killing them at one part per 2 million. The DDT met expectations of efficacy, and a mass delousing ensued (Curtin 1953, Dews 1953).

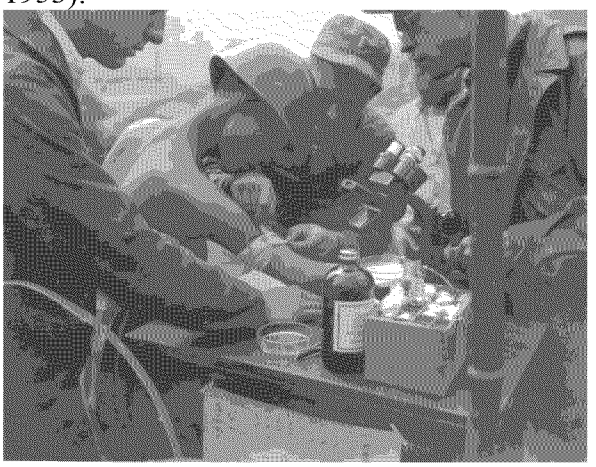


Figure 3: Lt. Nibley (USA) and CDR Hurlbut (USN) check Korean subject's DDT armband as part of test for louse resistance to DDT. Photos: US Navy.

For the resistance test, South Korean soldiers were employed and an arm band was placed on each arm of the shirtless volunteers (Figure 5). One arm band was treated with 10% DDT while the other was left untreated. Lice were placed under each arm band and counted at 24 and 48 hours. No difference was observed between the treated and untreated arm bands, which strongly suggested louse resistance to DDT. The US authorities approved the use of a new insecticide, lindane, which provided effective louse control.

Figure 5: Republic of Korea Soldiers volunteered as subjects for the DDT and body lice test of CDR H.S. Hurlbut, 7 April 1951. Photo U.S. Navy

Implementing the use of lindane at the Koje Island POW camp was a challenge. POWs, who were accustomed to standing in long lines to be treated with ineffective DDT, had no faith that the new product would be any better and many refused to go for treatment. On the first day, some POWs submitted to treatment; once they saw how well lindane worked, word quickly spread, and the rest of the camp complied (Dews 1960). In a short time, the louse infestation on Koje was brought under control.

Japanese encephalitis, a viral mosquito-borne disease, was also of concern because 300 cases had occurred in US military personnel between August and October 1950. Little was known about this disease, so blood sera from 210 of these cases were sent to the 406th Medical Laboratory at Camp Zama, Japan, to determine its etiology.

Vivax malaria, a parasitic mosquito-borne disease, was of great concern, with infection rates of 8.3, 3.2, and 1.9/1000/year for 1951, 1952, and 1953, respectively (Cowdrey 1990). Acute and latent forms of the disease were expressed. Soldiers affected with the acute form showed disease symptoms within two weeks of exposure and became medical liabilities in Korea. Those affected with the latent form showed disease symptoms months to a year later. Because deployments to Korea were 19 months or less, many soldiers returned home with inactive latent malaria parasites in their liver. Later, when the disease appeared in these soldiers, health authorities became concerned that malaria would reestablish itself in the US. Chloroquine was the chemoprophylaxis of choice, but it only suppressed blood parasites and did not affect the parasitic liver stage. Primaquine, which killed the liver parasite, was approved for use during this period, thus reducing latent cases and relieving concerns about reintroducing malaria into the US (Coatney et al. 1953, Hunter 1953, Archambeault 1954, Marshall 1954, Pruitt 1954, Brundage 2003).

Epidemiological studies were conducted in South Korea to determine the malaria infection rate of Korean civilians (Murdoch and Lueders 1953, Marshall 1954)(Figure 6), and military entomologists (Army, Air Force, Navy)

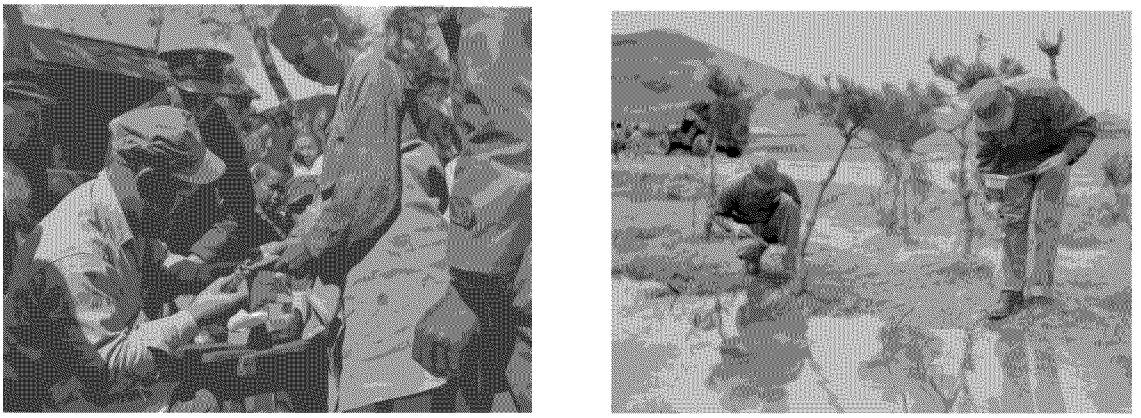


Figure 4: Left: R. l. Thomas, HM1, observed by Chief D. B. Webb, continues his testing of possible malaria subjects, Koje Island, 9 Apr 1951. Right: CWO R. S. MacDonough and CDR H. S. Hurlbut inspect stagnant pool somewhere in Korea for mosquito larvae, no date. Photos: US Navy.

were instrumental in preventing the disease through the application of pesticides by ground and air, and through advocating the use of uniforms treated with repellents (M-1960 contained 30% 2-butyl-2-ethyl-1,3-propanediol for protection against mosquitoes and biting flies, 30% N-butylacetanilide for ticks, 30% benzyl benzoate for chiggers and fleas, and 10% of an emulsifier, Tween 80 [polyoxyethylene ether of sorbitan monooleate])(Gupta et al. 2003).

Epidemic hemorrhagic fever (now known as hantavirus) was a viral disease of great importance. Over 3,000 UN soldiers were affected, with an initial mortality rate of 14.6% that was reduced to 2.7% as medical providers learned more about the management of this infection (Pruitt 1954). However, very little was known about this disease, so studies began in earnest to understand its etiology and how to control and/or prevent it. Studies of Japanese literature suggested this was the same disease encountered by Japanese military forces in Manchuria during their 1938-1940 campaign, and notes from the Japanese experience were useful (Katz 1954, Traub et al. 1954). Studies of the agent were confounded because it had been observed that application of the repellent M-1960 appeared to reduce epidemic hemorrhagic fever rates, suggesting that a vector was involved in the transmission cycle (Traub 1954). Initially thought to be a vector-borne disease with a rodent reservoir, all potential vectors (mites, mosquitoes, black flies, and fleas) were studied (Traub et al. 1954). In 1976, the virus was isolated from the black-striped mouse, *Apodemus agrarius* (Lee et al. 1978), and named Hantaan virus after the Hantaan River where it was first isolated.

During the war, many rodents were live-captured to study hantaviral and other diseases, but live traps were in short supply and those that were available were quickly acquired by others for personal use (Applewhite 1953). Therefore, soldiers of the preventive medicine detachments improvised and built traps from beer cans and mouse snap-traps, both of which were abundant (Bevier 1953). These "Beer Can Traps" were made by cutting off the top of the can and affixing the mouse trap to the open end, with the

trigger extending into the can. A flat piece of metal was placed over the wire "snap" loop so that once the trap was triggered, the loop covered the open end of the can and trapped the rodent.

During WWII, scrub typhus was feared more than malaria in parts of Southeast Asia, but only 8 UN soldiers acquired the disease during the Korean War even though thousands of cases were diagnosed in the civilian population (Ley and Markelz 1961). Similarly, tick-borne disease was not a factor, as ticks were uncommon and very few soldiers complained of tick attachment (Traub 1954). The lack of trees and leaf litter may have limited the habitats capable of supporting ticks that parasitize humans.

A history of entomology during the Korean War would not be complete without discussing the contributions of the 406th Medical Laboratory, Camp Zama, Japan. The 406th served as the primary laboratory supporting entomological studies throughout the war, and entomologists in Japan worked closely with entomologists stationed in Korea. The laboratory conducted epidemiological, virological and entomological studies on arthropod- and rodent-borne diseases, and provided mounted specimens to US and regional museums (US Army 1953). Arthropods studied and mounted included mosquitoes, black flies, filth flies, mites, lice, and fleas. In addition, birds and small mammals were studied and mounted. The laboratory expanded to meet its research demands, and many Japanese joined the staff. Some of the new employees were sympathetic to Communism, a situation that caused friction subsequently (Lockwood 2009).

During the winter of 1950-1951, reports of massive disease outbreaks in the North Korean military and among civilian and Chinese military populations were received. These reports also stated that the North Korean authorities were doing nothing to mitigate the problem. Several reports claimed that the "Black Death" was spreading throughout North Korea. Black Death to US medical personnel meant flea-borne plague, *Yersinia pestis*. If UN forces were to move north in the spring, they would encounter this disease and needed to be prepared. To validate the reports, the US sent COL Crawford F. Sams into North Korea to investigate. COL Sams infiltrated North Korea near Wonsan and determined the disease to be hemorrhagic smallpox, not plague. US military personnel were vaccinated against smallpox, with the result that only 4 soldiers developed the disease during the war (Waldo 1955). However, the North Korean civilian population suffered tremendously and its population dropped from 11 to 3 million people (Sams 1998).

In the spring of 1951, North Korea and China accused the US of engaging in biological warfare and cited multiple examples of attacks with a variety of arthropods (Collembola, crickets, Plecopterans, etc.) and small rodents (moles) harboring disease (Lockwood 2009). The Communist sympathizers within the 406th Medical Laboratory claimed that the US was conducting biological warfare studies using arthropods and rodents. To most people, these accusations seemed ludicrous because the supposed vectors were not known to transmit disease to humans, and research on how to prevent, treat, and control a disease is not the same as biological warfare studies. The Communists also claimed that the US protection given to Japanese scientists

(who practiced biological warfare during WWII) in exchange for their secrets was further evidence that the US was engaged in biowarfare. A team of "experts" sympathetic to the Communist cause was sent to investigate. Their report condemned the US, but upon questioning, the team admitted that they never saw the evidence; their report was based exclusively on what they had been told or shown by the North Koreans and Chinese. The report caused more controversy but was considered biased.

The US denied all allegations concerning the use of biological weapons, pointing out that disease was already rampant in both Koreas and without medical intervention many people would fall ill and die. Two recent books (Lockwood 2009, Endicott and Hagerman 1998) provide insights on this issue, as well as references to other books, literature, and documentation.

Entomologists from the Army, Air Force, and Navy served during the Korean War. Army entomologists served on the 8th Army Surgeon's Staff and in the Preventive Medicine Company and Survey Detachments. LTC Samuel O. Hill (Fig. 7a), of the 8th Army Surgeon's Staff, was the first entomologist to enter the combat zone (Bunn and Webb 1961). He was later replaced by LTC Samuel C. Dews (Figure 8), who served in this position for the remainder of the war. In a 1953 report, LTC Dews reported that 38 entomologists served in Korea during the war, but Bunn and Webb (1961) reported 65 entomologists; the difference may lie in the numbers who served in units only (38) versus those who served in units plus those who were conducting research (65). Traub et al. (1954) is an example of those involved in research. Further studies are needed to determine exact numbers. Lieutenant Carlyle Nibley Jr. (Figure. 4) and Captain Robert Altman (Figure. 7b) served in Korea, and many of authors listed in the reference section of this paper also served. In 1954, COL (ret.) Harold D. Newson and LTC (ret.) Alexander A. Hubert served in Korea (Newson and Hubert, personal communication).

The 37th Preventive Medicine (PM) Company and 10 different PM Detachments saw service during the Korean War (Table 1). In 1950, two types of detachments existed and were in the middle of a name change. Malaria Control Detachments were redesignated as PM Control Detachments and Malaria Survey Detachments were redesignated as PM Survey Detachments. Two sanitary engineers typically served in the PM Control Detachments, whereas an entomologist and a parasitologist served in the PM Survey Detachments. Nine enlisted personnel were assigned to each of these detachments (Curtin and Spitzer 1953).

In September 1950, the 38th and 207th PM Survey Detachments were moved from Japan to Korea and were the first two detachments deployed to the war zone. Seven PM Control Detachments served in Korea and one served in Japan for the duration of the war. Similarly, three PM Survey detachments served in Korea and one served for the duration in Japan. Table 2 provides a summary of the entomological work performed by the PM Survey Detachments.

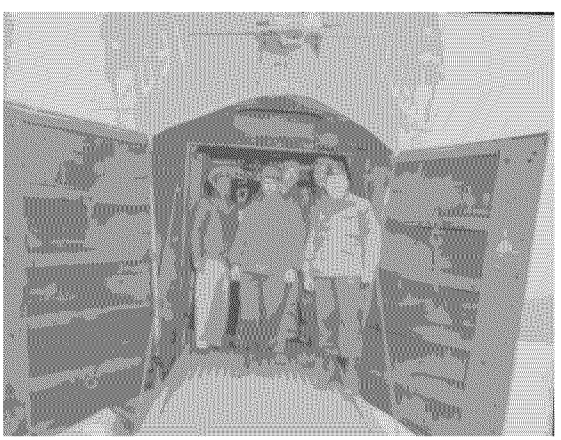



Figure 5: Left: Opened ramp of USS LSIL 1091 with LTJG G.P. Miller and LTC Sam Hill, 26 Mar 1951. Right: L-R, CPT James B. Butler MC, USN, CPT Robert Altman, 37th PM Company, 8th Army, 1LT Lindenberg , CWOHC MacDonough on a mountain overlookign Koje-Do bay, 20 Mar 1951; Photos: US Navy.

Figure 6: Members of the Preventive Medicine Division, Medical Section, HQs, Eighth US Army Korea. L/R: LTC Edward C. Mulliniks, Asst Chief, PM; 1LT David L. Griffith, Public Health Education Officer; MAJ Morris Krasnoff, Sanitary Engineer; CDR Leonard M. Schuman, Cold Injury Team and Consultant; LTC Irvine B. Marshall, Chief, PM Division; LTC Samuel C. Dews, Entomologist; CPT Ralph Takami, Medical Intelligence Consultant, Jan 1952. Photo: US Army.

Table 1. Preventive Medicine units that served in Korea or Japan, 1950-1954.[1]

Unit[2]	Date served in War	Country	Activation/inactivation
6th PM Survey	Mar 1950-Dec 1954	Japan	activated Feb 1952, inactivated Oct 1954
10th PM Control	Jul 1951-Dec 1954	Korea	activated Feb 1952,
17th Malaria Survey	Jan 1950-Jul 1950	Japan	Inactivated Jul 1950
37th PM Company	Fall 1950	Korea	
38th PM Survey	Jan 1950-Aug 1950	Japan	
38th PM Survey	Sep 1950-Dec 1954	Korea	Inactivated Sep 2007
78th PM Control	Apr 1953-Dec 1954	Korea	inactivated after Dec 1954
118th PM Control	Jan 1950-Dec 1954	Japan	
151st PM Control	Feb 1952-Oct 1954	Korea	activated Feb 1952, inactivated Oct 1954
152nd PM Control	Nov 1951-Dec 1954	Korea	activated Feb 1952
153rd PM Control	Feb 1952-Dec 1954	Korea	activated Jan 1952, inactivated Jan 1955
154th PM Control	Jan 1952-Oct 1954	Korea	inactivated Nov 1954?
155th PM Control	Jan 1952-Oct 1954	Korea	inactivated Nov 1954?
207th PM Survey	Jan 1950-Aug 1950	Japan	
207th PM Survey	Sep 1950-Dec 1954	Korea	
219th PM Survey	Jan 1952-Dec 1954	Korea	activated Jan 1952, inactivated after Dec 1954
406th General Lab	Jan 1950-Dec 1954	Japan	

[1]Data derived from US Army Directory and Station Lists for the Korean War period.
[2]Except for the 37th PM Company and 406th General Laboratory, all units are detachments with the 17th Malaria Survey Detachment being inactivated before the name was changed to PM Survey Detachments.

Table 2. Identifications and miles travelled by the 219th Preventive Medicine Survey Detachment, 1 Mar-15 Sep 1952. [1]

Total identifications made	73,152
Mosquito larvae	35,152
Mosquito adults	30,195
Mites	4,212
Lice	2,206
Fleas	91
Rats	779
Other mammals	337
Travel miles logged	36,718

[1]Data from Curtin and Spitzer (1953).

Figure 7: Aircraft used by the US Army to control mosquitoes and filth flies during the Korean War.

While most Army vector control missions were ground based, it became necessary for the Army to engage in aerial spray missions in the narrow, small valleys where the larger US Air Force aircraft could not go. The Army modified the L-13 and OH1/L-19 aircraft (Figure 9) for aerial spraying and sprayed DDT for the control of mosquitoes and filth flies (Harder 1953a, b).

Navy entomologists primarily served in the port cities that were feeding Korea with essential supplies, equipment, and troops. They were also essential to vector control at the Koje Island POW camp and during malaria epidemiological studies around port cities. At present, we believe six Navy entomologists served during the Korean War, with CDR H. S. Hurlbut (Figure 10a) confirmed as being present because he wrote about his experiences and appears in photographs. Many of Hurlbut's photos include CWO R. S. MacDonough (Figure 10b), but we have not determined the latter's association with entomology.

The Korean War was the Air Force's first war as a separate service. To meet the needs for aerial spray missions, the Air Force activated the 1st Epidemiological Flight in May 1951. The mission was flown on 17 June (Muchmore and Read 1953) and the first season was completed on October 8, 1951 (Nowell 1954, Lumpkin and Konopnicki 1960). The Air Force used a variety of aircraft for the aerial spray mission: C-40, C-46, C-47, L-20, L-5, and the T-6. Aerial spray missions commonly targeted mosquitoes and filth flies to reduce disease affecting military and civilian populations. A DDT oil solution of 20% was commonly sprayed.

At the time of this writing, we are unable to determine which Air Force entomologists served in Korea, even though we have an extensive list of those who served in that capacity.

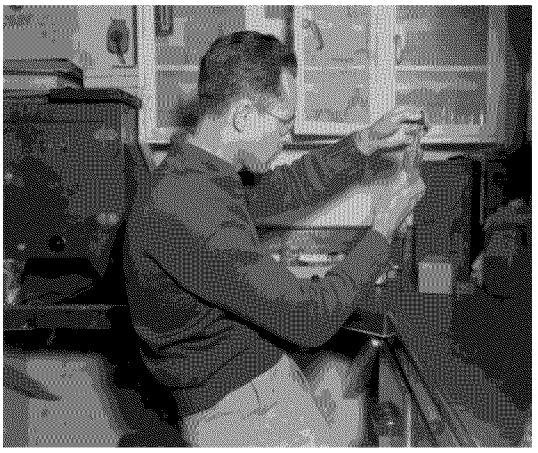


Figure 8: Top: CDR H. S. Hurlbut moves mosquito from collecting vial prior to examination, 3 Apr 1951. Bottom: CWO MacDonough dips stagnant stream for mosquito larvae, 1 Apr 1951. Photos: US Navy.

During the Korean War, the word "Mosquito" with a capital "M" referred not to an insect but to an airplane (Futrell 1983). The T-6 "Texan" was used as a Forward Air Controller, and it was commonly called the "Mosquito" by its pilots and ground crew (Fig. 11). Two theories have been advanced for this moniker. The first postulates the use of the call sign "Mosquito" as in "Mosquito 1, this is "Mosquito 2, over." Pilots and ground crews apparently liked this call sign and began calling the T-6 the "Mosquito" (Futrell 1983). An alternative explanation is that North Korean and Chinese prisoners called this aircraft a mosquito (Mogi in Korean) because they associated its buzzing around with the "bites" (bombs) that followed shortly thereafter (Morris 1997).

Much work remains to be done before we have a clear picture of military entomology during the Korean War. References for this presentation came from the US Army Center of Military History, Fort McNair, DC; the US Army Institute of Military History, Carlyle, PA; entomological, scientific and tropical medicine journals of the period (e.g., Mosquito News, Am J Hyg); collections of unpublished documents on file at the Armed Forces Pest Management Board (www.afpmb.org); books written about the Korean War; and Internet searches on subjects or people who may have served during that era.

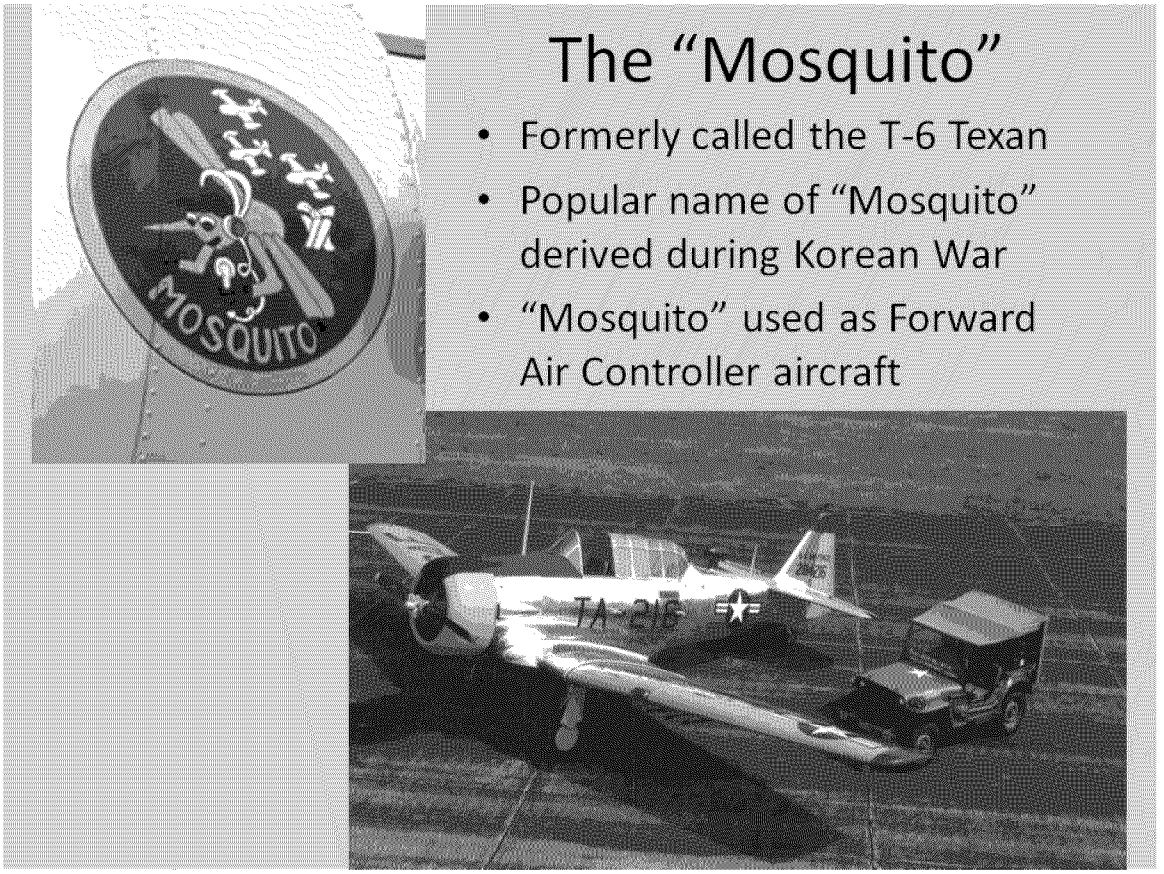


Figure 9: The T-6 Forward Air Controller aircraft earned its common name "Mosquito" during the Korean War.

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